



Original Research

A Comparison of United States Marine Corps Physical Fitness Test and Combat Fitness Test Results

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ABSTRACT

International Journal of Exercise Science 13(4): 1741-1755, 2020. The United States Marines Corps (USMC) have installed a Physical Fitness Test (PFT) to measure physical fitness levels and a Combat Fitness Test (CFT) to assess a Marine's functional fitness as it relates to the demands of combat operations. The PFT involves three events; pull-ups/push-ups (PU), two-minute abdominal crunches/sit-ups (AC), and a timed three-mile run (RUN). The CFT also involves three events; Movement to Contact (MTC), two-minute Ammunition Lift (AL), and Maneuver-Under-Fire (MANUF). It is of interest to determine if the PFT and CFT are both necessary. As such, the purpose of this study was to determine the degree of relationships between PFT (PU, AC, RUN, and total) and CFT (MTC, AL, MANUF, and total) scores of active duty Marines. The PFT and CFT scores from 19,678 active duty enlisted USMC males (age 22.5 ± 1.3 years, height 1.77 ± 0.07 m, body mass 79.4 ± 10.3 kg) were analyzed. Pearson correlation coefficients (r) were calculated between the PFT and CFT total scores as well as individual events. The PFT mean \pm sd scores were as follows: PU= 18.0 ± 5.0 (pull-ups), AC= 111.2 ± 9.0 (repetitions), RUN= 1377.0 ± 131.4 sec, PFT total= 249.6 ± 29.6 . The CFT mean \pm sd scores were as follows: MTC= 172.5 ± 16.3 sec, AL= 113.2 ± 10.4 repetitions, MANUF= 138.3 ± 17.2 sec, CFT total= 271.6 ± 25.6 . Moderate significant ($p < 0.01$) correlations were found between: the PFT total and MTC ($r = -0.47$), PFT total and MANUF ($r = -0.42$), PFT total and CFT total ($r = 0.50$), RUN and MTC ($r = 0.46$), RUN and CFT total ($r = -0.43$), & PU and CFT total ($r = 0.41$). Other correlations between variables yielded "no to low" association but were also significant due to the large sample size. Within the parameters of this study, PFT and CFT event scores demonstrated no to moderate correlations suggesting that different fitness characteristics are being assessed and supports the need for both the PFT and CFT assessments.

KEY WORDS: USMC, military, readiness

INTRODUCTION

The origins and history of the United States Marine Corps (USMC) have been well documented. The USMC's origins have been traced and established to Philadelphia in November 10, 1775 at Tun Tavern on Water Street. The USMC's creation was to augment naval forces during the Revolutionary War (36), today the USMC has grown to be one of the most effective fighting forces on the planet with assets spanning the entire globe.

Research by retired Colonel McGuire (13) indicates that the USMC began using physical fitness testing in the early 1900s. The USMC's Physical Fitness Test (PFT) has gone through many changes in scope including modifications for: certain ranks, age, and gender by 1971. Early forms of the modern PFT began in 1972 for males <46 years of age (pull-ups, sit-ups, three-mile run) and in 1975 for females <46 years of age (flexed arm hang, sit-ups, 1.5-mile run). In 1996 the 1.5-mile run for females was changed to the three-mile run and the pull-up was modified to a dead-hang (no kipping) for males. In 1997 all Marines regardless of age were required to take the PFT and the sit-up was changed to an abdominal crunch. In 2013 female pull-up implementation was initiated, eliminating the flexed arm hang for females in 2016. In the past few years the USMC has altered/adapted the PFT to include the hybrid pull-up/ push-up test (option of pull-ups or push-ups, lower max points for push-up option) and introduced a five-kilometer row option instead of three-mile run for Marines age 46 and older and those recommended by a primary health care provider based on a medical condition and approved by the Commanding Officer (CO) or Officer in Charge (OIC) (24,25,26).

The USMC's "PFT is a collective measure of general fitness Marines Corps-side. The PFT was specifically designed to test the strength and stamina of the upper body, midsection, and lower body as well as efficiency of the cardiovascular and respiratory systems" (24,25,26,27) to help ensure that all members of the USMC are battle-ready. The current USMC's PFT is taken once a year (between 1 January and 30 June) and comprised of three events; hybrid Pull-ups (PU)/Push-ups, two-minute timed abdominal crunches (AC), and timed three-mile run (RUN)/ Row option. All PFT events are required to be conducted in a single session, not to exceed two hours in duration (24,25,26,27).

The USMC implemented the Combat Fitness Test (CFT) in 2008 and began official scoring in the fall of 2009 (3). The CFT is a complement to the PFT and measures additional functional elements of general fitness to include agility, coordination and anaerobic capacity (26). The purpose of the USMC CFT is to;

Assess a Marine's physical capacity in a broad spectrum of combat related tasks. The CFT was specifically designed to evaluate strength, stamina, agility, and coordination as well as overall anaerobic capacity. The CFT is a complement to the PFT and measures the functional elements of combat fitness through execution of a series of events that represent every Marine's combat experience, emphasizing our ethos of "every Marine is a rifleman." (24,25).

The USMC CFT is taken once a year (between 1 July and 31 December) and consists of three timed events; movement to contact (MTC), ammunition lift (AL), and the maneuver under fire (MANUF). The sequence of these events is MTC, AL, and MANUF, no deviation from this sequence is authorized. All CFT events must be conducted in a single session, not to exceed two hours in duration and rest between events will be no less than five minutes (24,25,26,27).

Results from PFT and CFT events are then assessed and scored using USMC established scoring charts for each event based on gender and age. All Marines must meet/exceed minimum standards for each PFT and CFT event. Scores from each event are then combined and a total

PFT and CFT score is given. The PFT and CFT total scores are then used to determine PFT and CFT classification (1st Class, 2nd Class, 3rd Class, classification scores can be used for such things as promotions). USMC PFT and CFT classifications during the data range was first class (235-300), second class (200-234), third class (120-199) or fail (<119) (25).

Few studies have examined the relationship between the USMC PFT and CFT. A presentation by McGuire (13) examined the correlation of performance on USMC PFT and CFT to the physically demanding overall closed Military Occupational Specialty (MOS) testing score. This presentation/study expressed that correlations between a Marines overall closed MOS testing score and the PFT/CFT events should have equal or greater consideration than correlations of individual closed MOS events to PFT/CFT events and found that two PFT events (PU, RUN) and all CFT events (MTC, AL, MANUF) showed a strong correlation to overall closed-MOS physical tasks test scores, McGuire (13) concluded that "Performance on most USMC PFT and CFT events can serve as a sound basis for making valid inferences about a Marine's capability to perform physically demanding MOS tasks".

Research by Bartlett, Phillips, & Galarneau (3) analyzed performance scores and relationships from active duty Marines that completed the PFT from 2000 to 2012 and CFT from 2010 to 2012. The Bartlett et al. (3) study investigated descriptive characteristics, PFT and CFT median composite (Total) scores, average PFT and CFT event performance, percentage of females who met male CFT minimum requirement by age group and percentage of participants who performed in target range on CFT events. Notable findings from the median total scores demonstrated a steady improvement in median total PFT scores for both females and males for the study period. All Marines had higher total scores on the CFT, and female and male Marines similarly obtained first class PFT (76.9% and 80.2%, respectively) and CFT (83.8% and 86.3%, respectively) total scores. Notable findings from the percentage of females who met male CFT component minimum requirements showed the majority of females in each age group could pass the current male CFT scoring standard. Finally, the percentage of participants who performed in target range (high, medium and low) demonstrated the majority of males performed the AL and MANUF event in the highest performance group (93.9% for AL and 86.6% for MANUF). The majority of females (approximately 70%) performed in the medium group for all events (3). It is noteworthy to mention that the "target range" for each event was not based on age, sex or USMC CFT scoring tables for each event but rather by unadjusted increments of one minute (MTC and MANUF) and 25 repetitions (AL).

In recent years the USMC has altered/adapted the PFT and CFT events, scoring tables, and body composition program (BCP) to ensure standards are relevant, focused, and incentivizes behavior toward a healthy and fit force (16). As professional warrior-athletes, every Marine must be physically fit regardless of age, grade, gender or duty assignment (24,25,26,27). Though current USMC PFT and CFT testing parameters are different from when previous studies or articles were written (3,8,13,14,16,30,33,37), information reported previously is useful in understanding why such modifications were made to the PFT and CFT protocols. While the aforementioned studies (3,13) begin the conversation about the USMC PFT and CFT relationship they did not explore correlation data between PFT and CFT events or total scores. Hence, the

purpose of this study was to quantify the relationship between the USMC PFT and CFT event and total scores for the period of 01/01/2017 to 08/12/2018. To the best of our knowledge, this is the first systematic examination of the relationship between the USMC PFT and CFT event and total scores and should provide insight regarding the necessity of administering both the PFT and CFT. It was hypothesized that there would be moderate to high relationships between the USMC PFT and CFT event and total scores.

METHODS

Participants

This study was an examination of pre-existing data as collected by the USCM and archived in the USMC Operational Data Store Enterprise System. The participant sample examined in the current study was comprised of 19,678 male Active Duty enlisted United States Marines between the ages of 21-25. The data examined was from USMC fitness records collected during the period of between 01/01/2017 to 08/12/2018. Permission to conduct this study of existing data was obtained from the Institutional Review Board at Southern Utah University and was approved as an exempt status (SUU IRB approval #06-022019a). "This research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science" as described previously (15).

G*POWER 3.1.9.2 (Universitat Kiel, Germany) software was utilized to conduct a power analysis (5) which indicated that 46 participants were required. The power analysis was based on the following assumptions: medium-high effect size of $ES=0.40$ (5), statistical power $1-\beta=0.80$ (two-tailed), and $\alpha=0.05$. Sample size examined in the current study consisted of $n=19,678$ Marines.

Protocol

The data for this study was obtained from the USMC Operational Data Store Enterprise System. The data consisted of age, height, weight and performance results on the PFT and CFT. Specifically, the assessed scores for: PFT total, PU, AC, RUN, CFT total, MTC, AL, and MANUF (Individuals with push-up, rowing or scores performed at altitude above 4500 feet mean sea level were not included).

Local USMC commands input PFT and CFT event performance data and calculate scores by referencing the appropriate event table for the Marine Corps physical fitness and combat fitness tests in the current Marine Corps Order (25,26,27).

The manner in which the PFT and CFT assessments were carried out are described below. All USMC PFT procedures and necessary equipment to conduct the assessments can be found by referencing MCO 6100.13A (25), MCBul 6100 (24), and MCO 6100.13 W/CH 2 (27). Below are pertinent event procedures for the USMC PFT;

Hybrid Pull-Up/Push-Up test: This event gives Marines the option to do either pull-ups or push-ups. All Marines should be encouraged to do pull-ups as this is a better field test of dynamic upper body strength. Additionally, maximum points

on the hybrid pull-up/push-up test can only be earned by doing pullups (24,25). It should be noted that the scores reported in this manuscript only include those who performed pull-ups.

Pull-up: The intent is to execute a vertical “dead hang” pull-up. A certain amount of inherent body movement will occur as the pull-up is executed. However, the intent is to avoid a pendulum-like motion that enhances the ability to execute the pull-up. Whipping, kicking, or kipping of the body or legs, or any leg movement used to assist in the vertical progression of the pull-up is not authorized. If observed, the repetition does not count for score (24,25,27).

Abdominal Crunch: This is a timed event to do as many abdominal crunches as possible in two minutes. This event can be conducted either indoors or outdoors. Arms will be folded across the chest or rib cage with no gap between the arms and chest/rib cage. The hands must be clasped on the upper arm between the elbow and shoulder. Both arms must remain in constant contact with chest/rib cage throughout the exercise. A single repetition consists of raising the upper body from the starting position with shoulder blades touching the deck until both forearms or elbows simultaneously touch the thighs, and then return to the starting position with the shoulder blades touching the deck. The buttocks will remain in constant contact with the deck throughout the event. No arching of the lower back or lifting of the buttocks is permitted. An assistant may be used to hold a Marine's legs or feet, at or below the knees in whatever manner that is most comfortable for the Marine. Kneeling or sitting on the Marine's feet is permitted (24,25,27).

Three-Mile Run: This is a timed event and can be conducted either indoors or outdoors. Running this event on a treadmill is not authorized. The course should be an “out and back” or a wide loop course. The run course should not include numerous sharp turns that would force a participant to slow down excessively to remain on the course. A determination as to whether the track is a yard or meter track must be made and the track measured to ensure accurate distance prior to conducting the PFT. Run courses should not require a Marine to do more than 12 laps to cover three miles, (e.g., a course should not be shorter than 440-yards per lap) (24,25,27).

All USMC CFT procedures can be found by referencing MCO 6100.13A (25), MCBul 6100 (24), and MCO 6100.13 W/CH 2 (27). Below is pertinent information about the USMC CFT and event procedures;

Procedures; Uniform: The only authorized uniform for the CFT is the Marine Corps Combat Utility Uniform and boots. Watch cap, kneepads/elbow pads and gloves may be worn, as required. For the AL event, Marines will wear a green short-sleeve t-shirt so that lock out of the elbows can be observed. The blouse will be worn for the MANUF event. COs/OICs may authorize Marines to remove blouses for the running of the MTC event (25).

Movement to Contact (MTC); The run course will be 880 yards and must be measured for accuracy and set over reasonably level ground. Prior to the conduct of this event, the Force Fitness Instructors (FFI) or Command Physical Training Representative (CPTR) will ensure the running surface is free from hazards or debris that can cause injury to MTC participants. This event can be conducted on a track or measured surface and should not include numerous sharp turns that would force a participant to slow down excessively to remain on the course. A wide turnaround point will be implemented to prevent Marines from having to stop and turnaround, causing a loss in time on the event (24,25,27).

Ammunition Lift (AL); This is a timed event with a two-minute time limit. This event can be conducted either indoors or outdoors. The AL is a repetitive lift of a 30-pound ammunition can from shoulder height to overhead. The partner counting repetitions will be located to the side (approximately a 90-degree angle) of the Marine performing the AL in order to observe elbow lockout and prevent injury should the participant drop or return the ammunition can to the deck. Starting position for the AL is to hold the ammunition can sideways at shoulder height with both hands, handle facing away from the participant. The proper lifting technique is head up, chest elevated and lumbar curve maintained. Feet will remain shoulder-width apart or staggered in a basic-warrior stance position. The ammunition can must be lifted to a point overhead where the elbows are momentarily locked out. The ammunition can does not have to be lifted directly overhead. Once lock out is achieved, the ammunition can will be lowered to a point where the top of the can is at or below chin level. Once the ammo can is returned to this level, this counts as one repetition. To reach this level, Marines may have to widen the distance between elbows. Marines are encouraged to use their legs to generate upward momentum of the ammunition can, especially when fatigued. There is no penalty if Marines choose not to use their legs. Alteration of stance during the AL is permissible. Marines are authorized to rest during the AL. The ammunition can may be held in the starting position or placed on the deck. If placed on the deck, the ammunition can will be lowered in a controlled movement and not thrown or dropped. Once lowered to the deck, no assistance can be provided when returning the ammunition can to the starting position. Proper technique will be utilized when returning to the starting position (24,25,27).

Maneuver Under Fire (MANUF); The MANUF is a timed event to be conducted outdoors or an indoor turf field at least 100 yards in length in accordance with Figure 3-1. The MANUF course should be constructed on a smooth and level grass surface, preferably a football or soccer field. Prior to the conduct of this event, the FFI or CPTR will ensure the running surface is free from hazards or debris that can cause injury to participants. The MANUF is a 300-yard shuttle run that includes a variety of combat-related tasks, to include crawls, buddy drags/carries, ammunition resupply, grenade throw, and agility running. Prior to execution, the primary monitor will partner Marines by weight (within 10 pounds) and approximate height (within 6 inches) and assign a lane (24,25,27).

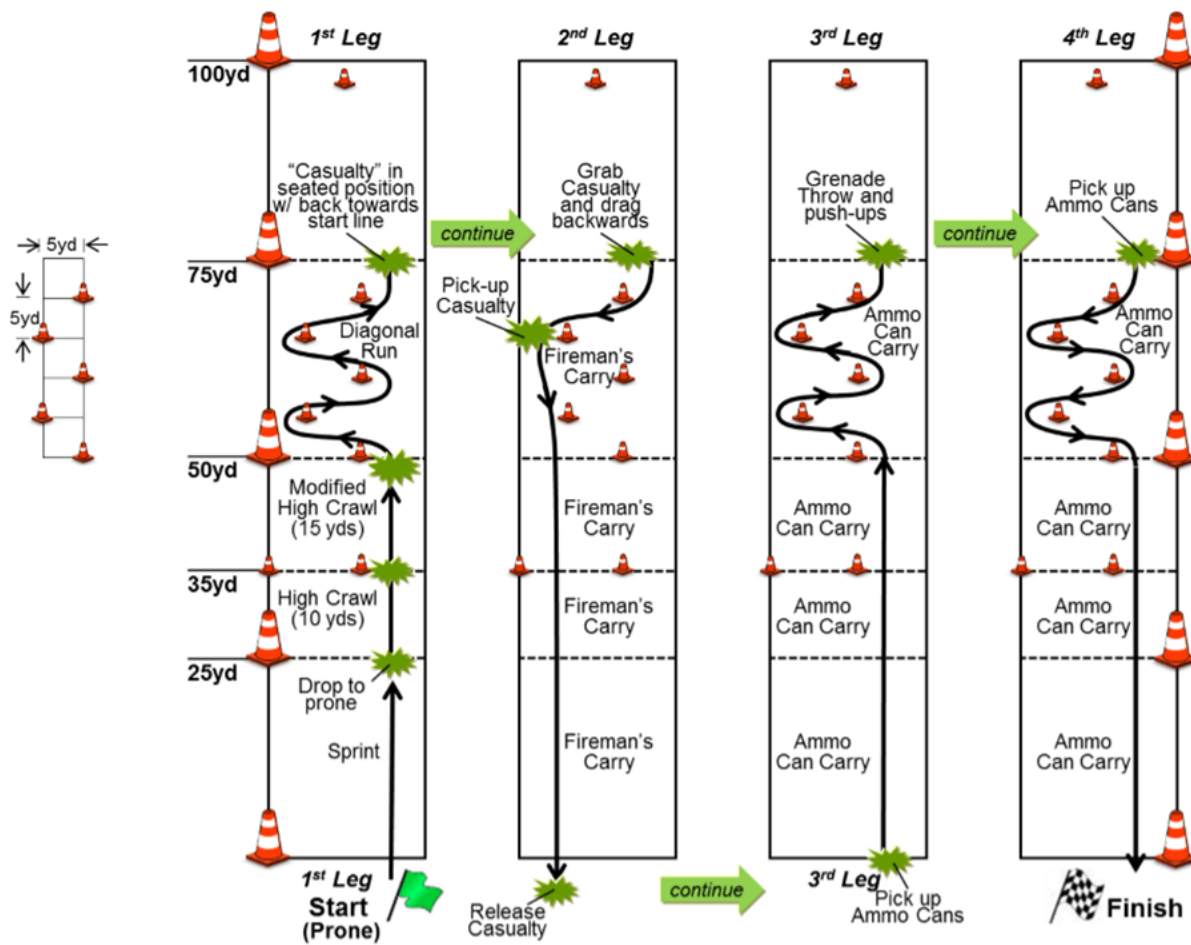


Figure 1. MANUF layout. Diagram not to scale. All events occur within one (same) lane (~7yd wide). *Dimensions are in yards. (25) (Figure reprinted with permission of the USMC).

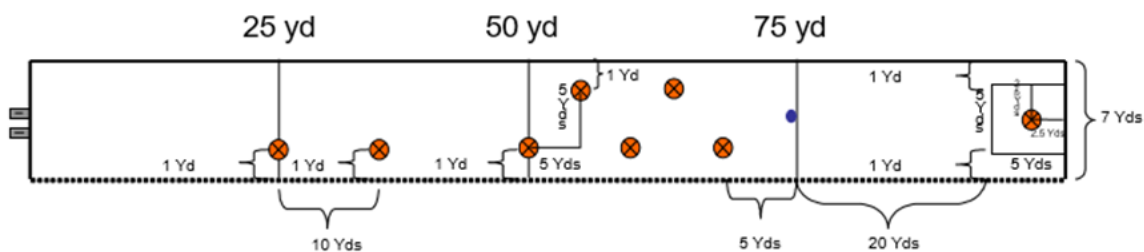


Figure 2. MANUF Lane markings. Diagram not to scale. \square = 30 lb Ammo Cans, \bullet = Dummy grenade, \circ = Small cone, pylon, or another visible marker. * Dimensions are in yards and pounds. (25) (Figure reprinted with permission of the USMC).

Statistical Analysis

The mean and standard deviation (SD) was calculated for the Marine's demographic information. Likewise, the mean and SD was calculated for the: PFT total, PFT event, CFT total, and CFT event scores. Pearson correlation coefficients (r) were calculated between the PFT and CFT total scores as well as individual events. Significance was considered as $\alpha \leq 0.05$ when

an $|ES| \geq 0.40$ was detected. The threshold for effect size was established based on Cohen's (5) ES criteria where a moderate ES ranges from $r = |0.30-0.50|$ and large = $|0.50|$. As such it was considered that a moderate to large ES was consistent with an $r = |0.40|$. Statistical analysis were conducted with MS Excel 2013. The Excel spreadsheet was peer reviewed for accuracy as suggested by AlTarawneh and Thorne (2).

RESULTS

Descriptive information of the Marines are presented in Table 1 ($n=19678$). Table 2 provides the mean and standard deviation for the USMC PFT events and PFT total score. Table 3 presents the mean and standard deviation for the USMC CFT events and CFT total score. Table 4 displays the correlations between the PFT and CFT events and total scores.

Table 1. USCM Descriptive Information

USMC Active Duty	Age (years)	Height (m)	Mass (kg)
Males ($n=19678$)	22.5 \pm 1.3	1.77 \pm 0.07	79.4 \pm 10.3

*mean \pm standard deviation

Table 2. USMC Physical Fitness Test (PFT) Scores

USMC Active Duty	PU (reps)	AC (reps)	RUN (Seconds)	PFT Total Score
Males ($n=19678$)	18.0 \pm 5.0	111.2 \pm 9.0	1377.0 \pm 131.4	249.6 \pm 29.6

* mean \pm standard deviation, PU-pull-ups, AC-abdominal crunch, RUN-3-mile run.

Table 3. USMC Combat Fitness Test Scores

USMC Active Duty	MTC (Seconds)	AL (Reps)	MANUF (Seconds)	CFT Total Score
Males ($n=19678$)	172.5 \pm 16.3	113.2 \pm 10.4	138.3 \pm 17.2	271.6 \pm 25.6

* mean \pm standard deviation, MTC-movement to contact, AL-ammunition lift, MANUF-maneuver under fire.

Table 4. Correlation Matrix PFT and CFT

	MTC (Seconds)	AL (Reps)	MANUF (Seconds)	CFT Total
PU (Reps)	-0.36	0.18	-0.34	0.41*
AC (Reps)	-0.19	0.16	-0.20	0.25
RUN (Seconds)	0.46*	-0.14	0.37	-0.43*
PFT Total	-0.47*	0.20	-0.42*	0.50*

*P-value <0.05 and $|ES| \geq 0.40$, PU-push-ups, AC-abdominal crunch, RUN-3-mile run, MTC-movement to contact, AL-ammunition lift, MANUF-maneuver under fire.

DISCUSSION

The purpose of this study was to describe relationship between the PFT and CFT assessments required by active duty United States Marines between the dates of 01/01/2017 to 08/12/2018. It was hypothesized that the USMC PFT and CFT event and total scores would exhibit moderate to high association. The results of the study indicated that correlations between the PFT and CFT events and total scores demonstrated significant yet weak to moderate relationships. These weak to moderate associations indicate that some of the PFT and CFT events appear similar in nature while others appear to be testing different physical performance characteristics. The implications of the current research strengthen the concept of implementation and execution of both the USMC CFT and PFT assessments.

When investigating the correlation between the RUN and MTC events we observed a PCC of $r=0.46$ indicating a moderate relationship suggesting these events scores are due to a degree from common factors (CD-coefficient of determination equals $r^2=0.21$). With that said, some key differences between the RUN and MTC are: RUN= 3-mile run (4.84 Km or 5280-yards) is performed where space and requirements dictate (ie. trail/sidewalk/road), may have a turnaround point (out and back run), Marines may wear Marine Corps approved T-shirt, shorts, socks and running shoes, and the event sequence is at the discretion of the CO/OIC (24, 25, 27). MTC= 880-yard run (or 0.80 Km) is typically performed on a running track with wide turns so that participants are not forced to slow/stop and turnaround, Marines wear the Combat Utility Uniform and boots, and the MTC event is performed first (24, 25, 27). These slight differences may help explain the moderate association value ($r=0.46$) and why these were found to have a significant $P\text{-value}<0.05$ and $|ES|\geq 0.40$. The energy system pathways that these events would rely on is also worth addressing. The MTC would rely more heavily on anaerobic glycolysis rather than the oxidative/aerobic system that the RUN would rely, based on the duration of the events (7).

The results of the study also demonstrated a moderate association between PFT and CFT total scores ($r=0.50$). However, the CD was $r=0.25$, or only 25% of the PFT and CFT scores come from common factors. In other words, 75% of the PFT and CFT scores are from uncommon factors. When exploring potential differences in physical performance characteristics between PFT and CFT events we detect subtle but apparent differences between the events. For example, when examining the MANUF and MTC consideration for agility, dynamic balance, coordination, and speed are some noticeable characteristics displayed that are less or nonexistent in PFT events. When investigating the PU and AL we note that both exhibit muscular endurance but the PU is isolated to the upper back, bicep, and shoulder girdle while the AL also encompasses full body push press strength and power output. Additionally, this study displayed that mean values for the PFT and CFT total scores were in the first-class category for PFT and CFT classifications. When comparing mean PFT event scores (Table 2) to USMC PFT scoring charts (25) mean scores for all PFT events (PU=83 points, AC=100 points, RUN= 69 points) were within 17 points of the maximum points possible (100 points) with 1 event (AC) obtaining a mean value of 100 points, the maximum possible. Likewise, when comparing mean CFT event scores (Table 3) to USMC CFT scoring charts mean point values for all CFT events (MTC=87, AL=98, MANUF=88) were

within 13 points of the maximum points possible (100 points). When examining the PFT and CFT total scores tables 2 and 3 show mean PFT and CFT total scores (249.6 and 271.6 respectively) were within the first-class category (1st 235 to 300) for PFT and CFT classification scores (25).

Since the implementation and official scoring of the USMC CFT other research and service branches have recognized the need and rationale for a CFT demonstrating that combat-focused training programs can reduce injury risk, overtraining and improve performance on general fitness tests (8,30,33,37). A study involving active duty U.S. Air Force female Airmen compared the results of the USMC CFT with the Air Force Physical Fitness Test (AFPFT) in order to determine if the addition of a CFT may be of value (14). Based on the findings the authors suggest that by adopting some elements of the CFT the U.S. Air Force can greatly improve its ability to assess combat fitness for women Airman (14). An article by then U.S. Navy Commander David Peterson (30) describes the need and rationale for service-specific CFT/Operational Fitness Test (OFT) and purposed an OFT that could be adopted and employed by the Navy. Since that time the U.S. Navy has adopted the Navy Operational Fitness and Fueling System (NOFFS) which provides “best in class” physical fitness and nutrition information (23). However, a CFT/OFT assessment is not currently employed by the U.S. Navy. The U.S. Army has recognized the need and rationale for a CFT and will begin transitioning from the pilot phase to initial operating capacity of its own Army Combat Fitness Test (ACFT) during the fall of 2019. The ACFT will become part of the Army fitness test of record in October 2020 (32).

A recent study by Mackey & DeFreitas (12) analyzing AFPFT longitudinal data for U.S. Air Force Reserve Officers’ Training Corps (ROTC) cadets. Their study indicated that only the sit-up and abdominal circumference showed a difference between class ranks (freshmen year to junior year and freshman year to senior year respectively) with no effect observed on pushups, run time or composite score. The results of the aforementioned study suggested that the AFPFT may not be sensitive enough to detect changes in physical fitness or distinguish between class ranks regarding physical fitness performance. The authors suggested that one limitation may be related to the training duration of the ROTC program (2 h per week) which provided a maintenance effect rather than an improvement in physical fitness performance. The authors also noted that the fitness components measured by the AFPFT: cardiovascular endurance (1.5-mile run), muscular endurance (1 min pushups and 1 min sit-ups), and body composition (abdominal circumference) do not assess muscular strength and flexibility. Hence, the authors suggested that the AFPFT may not be able to detect changes in physical fitness as related to muscular strength and flexibility.

The results of the current study in conjunction with the results of the aforementioned studies (9,11,13) further the conversation and justification in the use of more comprehensive methods to assess and evaluate service member fitness and physical capabilities. Based on the actions of the various military service branches it appears that most, if not all, service branches now recognize the value of incorporating some form of purposeful combat/performance/operational/functional fitness test/program. The addition of such

functional assessments are intended to improve physical fitness levels, injury prevention, broaden fitness assessment scope, and to properly prepare service members to accomplish missions safely and effectively (3,8,14,30,33,37).

The focus of the introduction to the current study discussed the evolution of fitness and combat readiness assessments solely through the lens of the armed forces. However, in recent years the military, academia, and exercise science communities have teamed up through research, meetings, conferences, and panels to examine current research findings and military assessments (11,19,20,22). Likewise, studies have also examined task performance readiness assessments, return-to-duty protocols, physical logistical capabilities and training strategies for military women; all in an effort to better assess and train military personnel for logistical and operational soldering tasks (4,9,18,21,34). The National Strength and Conditioning Association's second Blue Ribbon Panel (19) on military physical readiness held a focused discussion with Subject Matter Experts (SME) including representatives of U.S. Army, U.S. Marines, U.S. Navy, and U.S. Air Force to foster dialogue on military physical performance testing (19). The majority (95%) of the panel members concurred that "services should consider a tier II test focused on both health-related and skill related fitness components based on occupational, functional, and tactical military performance requirements" (19). The SME panel rated the health-related fitness components on 9 common military tasks ("jumping over obstacles, moving with agility, carrying heavy loads, dragging heavy loads, running long distances, moving quickly over short distances, climbing over obstacles, lifting heavy objects, loading equipment"). The SME panel determined that muscular strength, power, and endurance were the most critical components for completion of the tasks (19). With that said, a review of military assessment methods by Nikolaidis, Papaioannou, Rosemann, and Knechtle (17) found that although the military employs strength training, existing assessments focused primarily on muscle endurance rather than muscle strength. The authors suggested the use of muscle strength tests in order to evaluate the effectiveness of military fitness training (17). Our observations of the USMC PFT and CFT events is that there is a gap with respect to assessing muscular strength and muscular power. Given the aforementioned 9 common military tasks, it would seem that a full body strength and lower body power assessment should be added to the USMC PFT or CFT. For example, the one repetition maximum (1-RM) deadlift is considered a valid and reliable full body strength assessment (7). The deadlift is a rather simple movement and requires only an Olympic bar and associated weighted plates. A valid and reliable assessment of lower body power is the standing long jump (SLJ) (1,31). The SLJ movement is simple to execute and easy to administer (1,31). The addition of the 1-RM deadlift and the SLJ to the USMC PFT or CFT would appear prudent. It is pertinent to mention that the US Army selected the 3-RM trap bar deadlift and standing power throw (throwing a 4.5 KGs med-ball backwards overhead for maximum distance) as two of the ACFT events which may provide additional data on full body strength and lower body power.

Potential limitations to this study include participant event strategy to achieve a desired PFT/CFT total score rather than performing each event to maximum effort potential. The strategy of only doing what is needed to obtain a particular score range rather than maximum effort could have an effect on performance data. Time proximity of the PFT and CFT can also

be noted as potentially limiting, the PFT and CFT are required to be conducted annually between 1 January - 30 June and 1 July -31 December respectively (25). Limiting factors such as injury, climate, weather, and personal/physiological factors could influence performance during this timeframe between tests. Additionally, recording error (exactness of times and reps) and selected sample (enlisted males, ages 21-25) are also potential limitations.

The recent changes and additions to the USMC PFT and CFT events and scoring tables (25,26) will warrant further research to compare future fitness/scoring data with data previously collected. Additionally, future research with regard to gender and age can provide a broader understanding of PFT and CFT results. The USMC has announced that starting 01/01/2020 Marines will have the option of performing a timed plank as an alternative to the PFT AC with the time to obtain a perfect score (100 points) initially being four minutes and 20 seconds (35). The USMC is also considering a change in the rest interval between the CFT events from no less than five minutes to three minutes between events (35). The aforementioned upcoming changes along with the initiation of the U.S. Army's ACFT could provide a more in-depth data base leading to a more comprehensive understanding regarding the specificity of combat/performance/operational/functional fitness tests towards combat readiness.

In summary, within the parameters of this study, PFT and CFT event scores showed "weak" to "moderate" correlations suggesting that different physical qualities are being assessed and supports the need for both assessments. With the USMC CFT leading the way and the addition and implementation of such programs as the Army's ACFT and Navy's NOFFS most service branches are modernizing their approach to fitness and the ways to assess them. Full body strength and lower body power may be gaps in the current USMC testing which could be potentially addressed by incorporating the ACFT's 3-RM trap bar deadlift and standing power throw assessments. Potential PFT and CFT future research should focus on different age groups and female Marines to help develop a broader understanding between the relationship between the USMC PFT and CFT. Just as the unofficial Marine slogan "Improvise, Adapt and Overcome" the USMC continues to adapt their testing procedures and parameters to better evaluate the physical capabilities of their fighting force for the future.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the USMC for access and support. We also gratefully acknowledge the USMC Force Fitness Division and History Division for guidance, information support, and access in using figures/diagrams for this project.

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